LESSON MAKER PRO

Parabola Power

Use equivalent forms to reveal key features.

HIGH SCHOOL · AI-F.IF.8.a

AI-F.IF.8.a "For a quadratic function, use an algebraic process to find zeros, maxima, minima, and symmetry of the graph, and interpret these in terms of context."

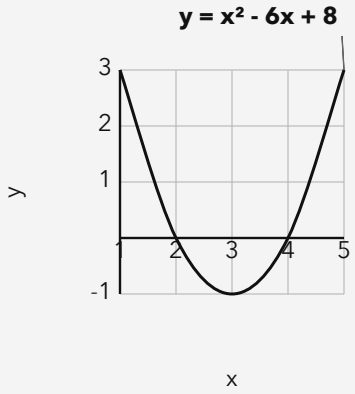
NAME _____ DATE _____

REVEAL THE FEATURES

In factored form, $f(x) = a(x - r)(x - s)$, the zeros are r and s. The axis of symmetry is halfway between the zeros. In vertex form, $f(x) = a(x - h)^2 + k$, the vertex is (h, k), and k is a maximum when a is negative or a minimum when a is positive.

WORKED EXAMPLE

The graph shows $y = x^2 - 6x + 8$. Find the zeros, minimum, and axis of symmetry.



1. Factor: $x^2 - 6x + 8 = (x - 2)(x - 4)$.
2. Set each factor equal to 0: $x = 2$ or $x = 4$.
3. Average the zeros: $(2 + 4)/2 = 3$. The vertex is (3, -1).

Answer: Zeros: x = 2 and x = 4. Minimum: -1 at x = 3. Axis of symmetry: x = 3.

PRACTICE 4 problems

1 1. For $f(x) = x^2 + 4x - 21$, find the zeros and the axis of symmetry.

ANSWER _____

2 2. For $f(x) = -x^2 + 10x - 21$, find the maximum value and the axis of symmetry.

ANSWER _____

3 3. For $f(x) = (x - 7)^2 - 9$, find the minimum value and the axis of symmetry.

ANSWER _____

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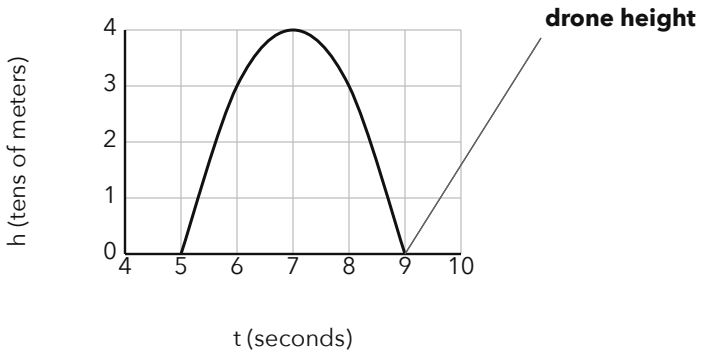
4 4. For $f(x) = 2(x + 1)(x - 5)$, find the zeros and the axis of symmetry.

ANSWER _____

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APPLY IT Show your work

1 A drone's height h, in tens of meters, is $h = -t^2 + 14t - 45$, where t is seconds. Use the graph. Write the function in factored form, then state when the drone is at ground level and its greatest height. This flight model applies only for $5 \le t \le 9$ seconds.



ANSWER

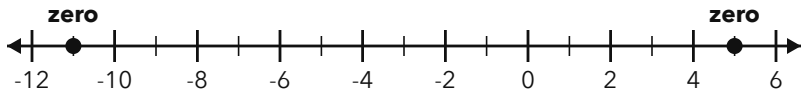
2 A student club models its profit P, in hundreds of dollars, by $P = -3n^2 + 30n - 63$, where n is the number of batches sold. Find the maximum profit and the two break-even numbers of batches.

WORK SPACE

ANSWER

CHALLENGE One step up

The number line marks the zeros of a downward-opening quadratic. Its function is $f(x) = -2(x + 11)(x - 5)$. Find the axis of symmetry and maximum value. Explain how the zeros help you find the axis.



WORK SPACE AND ANSWER

ANSWER KEY # Parabola Power

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	1. For $f(x) = x^2 + 4x - 21$, find the zeros and the axis of symmetry.	**Zeros: x = -7 and x = 3. Axis of symmetry: x = -2.**
2	2. For $f(x) = -x^2 + 10x - 21$, find the maximum value and the axis of symmetry.	**Maximum: 4 at x = 5. Axis of symmetry: x = 5.**
3	3. For $f(x) = (x - 7)^2 - 9$, find the minimum value and the axis of symmetry.	**Minimum: -9 at x = 7. Axis of symmetry: x = 7.**
4	4. For $f(x) = 2(x + 1)(x - 5)$, find the zeros and the axis of symmetry.	**Zeros: x = -1 and x = 5. Axis of symmetry: x = 2.**

PART 2 · APPLY IT

1. **h = -(t - 5)(t - 9). The drone is at ground level at 5 seconds and 9 seconds. Its greatest height is 40 meters at 7 seconds.** Factor to get -(t - 5)(t - 9), so the zeros are 5 and 9. Their midpoint is 7, and h(7) = 4 tens of meters.
2. **Maximum profit: $1,200 at 5 batches. Break-even: 3 batches and 7 batches.** Factor P = -3(n - 3)(n - 7), so break-even occurs at 3 and 7 batches. The axis is n = 5, and P(5) = 12 hundreds of dollars.

CHALLENGE

Axis of symmetry: x = -3. Maximum value: 128 at x = -3. The axis is halfway between the zeros because (-11 + 5)/2 = -3.

Accept equivalent factored or vertex forms when they are correct. For contextual answers, require both the numerical result and appropriate units.